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XXII.—*On the Geographical Distribution of the Common Oyster.* By G. WINTHER*.

APART from the oysters of the Mediterranean, which are here left out of consideration, the oyster is found along the coasts of the Bay of Biscay, from Vigo in Spain to Finisterre in France, and thence along the coasts of the Channel, the Irish, Scotch, and English seaboard as far as the Shetland Islands. The species reappears at Heligoland, on the western coast of Slesvig, in the Limfjord, the Aalbæk Bay in the Kattegat (near Frederikshavn or Fladstrand), and along the eastern shore of Jutland, as far as the fjord of Horsens, whilst on the coast of the Scandinavian peninsula oysters are found from a point south of Gothenborg along the Swedish and Norwegian coasts towards the bay of Christiania, and again on the south and west coast of Norway as far as the island of Tränen, near the polar circle. The Færoes and Iceland possess no oysters; and it is doubtful whether the American oyster is of the same species as that of Europe. In spite of its wide range northwards, the oyster must be regarded as a southern species, being most fully developed in the Channel and south of the Channel.

If now we look for peculiarities common to the whole of this portion of the west coast of Europe which is inhabited by the oyster, we meet with one phenomenon which exercises

* Abstract of a paper on the culture of oysters in Denmark, in 'Nordisk Tidsskrift for Fiskeri' (Copenhagen, 1876).

the greatest influence on Western Europe in point of climate and fauna, viz. the *Gulf-stream*, branches of which cross the northern portion of the Atlantic and touch precisely on the coasts in question.

According to the most modern researches, a branch of the *Gulf-stream* strikes the north-west corner of Spain and separates into two minor currents, of which one runs southwards past Vigo, along the coast of Spain and Portugal, whilst the other follows the shore of the Bay of Biscay to the western extremity of Brittany. The direction of this current along the French coast is therefore first northerly and then, along the S.W. coast of Brittany, north-westerly. After leaving the western extremity of Brittany the current maintains this north-westerly direction, following the edge of that submarine plateau on which both France and England are situated; and near the coast of Ireland this branch reunites with the main portion of the *Gulf-stream*, which, having crossed the Atlantic flows along the western shores of Ireland, Scotland, and the Shetland Islands. From this point the stream, following still the edge of the plateau, strikes across to the coast of Norway, which it touches first between Bergen and Trondhjem, spreading thence along the coast as far as the North Cape. From that branch of the *Gulf-stream* which, as we have described, crosses the mouth of the Channel, a minor branch diverges into the Channel, after passing which it spreads into the southern division of the North Sea, where its effects are well marked. After passing along the coast of Holland it touches Heligoland and the islands west of Slesvig, and follows the west coast of Jutland as far as the Skaw, where an ultimate bifurcation takes place, one branch passing to the Swedish coast, whilst the effects of the other, which runs southwards along the east coast of the Cimbric peninsula, can be traced as far as the Bay of Kiel.

All along these coast-lines, which are touched by the *Gulf-stream*, and where consequently the saltness and temperature of the water are proportionally high and independent of local circumstances, oysters are found. They constitute its specific area, according to the terminology of Mr. Forbes. How entirely the oyster depends on the *Gulf-stream* is beautifully illustrated in the Kattegat, where it does not reach so far south on the Swedish coast as on the Danish coast, obviously because the rather fresh current from the Baltic flows chiefly along the coast of Sweden, whilst the salt current from the North Sea follows the shore of Jutland. Oysters occur also near the island of Anhalt, in a place where a local northern current has often been observed; but the locality would not

appear to be otherwise favourable, as no fishery has been established there.

It may therefore be said, with justice, that the oyster inhabits the shores of Europe so far as these are touched more or less directly by the Gulf-stream, reaching northwards as far as the polar circle—the Channel and the south coast of England forming the centre of its distribution.

That the oyster does not occur on the shores of Iceland or the Færoes, is interesting in so far as it shows that its diffusion is due to the facility with which the spat is carried on by the current. No current coming from the English or other European coasts, and by which spat might be brought, impinges on the shores of Iceland or the Færoe Islands; the waters of the Gulf-stream by which they are washed come direct from the channel of the Bahamas.

If it be granted that the oyster has been carried to its present stations by the various branches of the Gulf-stream, it may be concluded that its specific centre is the place where that stream first reaches the continent of Europe, viz. the west coast of Spain, from which it has afterwards spread southward into the Mediterranean, and northwards as far as the polar circle. This, again, would be a point to be considered in settling the question as to the physical conditions accompanying the deposition of the Crag formation in England and the strata north of Gothenborg near Uddewalla, in which oysters occur in a fossil state.

But though oysters occur along the whole of the line indicated, they are by no means equally plentiful or well-developed at all points. Oyster-banks occur in many places, even as far north as Bergen in Norway; but those along the shores of England and France seem by nature to be the richest. On these banks, which are situated at varying distances from the shore, and where the oysters live in the pure water entering from the Atlantic, having a saltness of 3·5 or 3·6, they grow to a good size and produce many young; but they do not reach that fulness and delicacy which is obtained by moving them from the breeding-places to other localities exhibiting certain peculiar conditions. The places where oyster-culture succeeds have this in common, that they are protected by islands or shoals against the immediate influence of the open sea, and that the sea-water is diluted by the fresh water of rivers charged with a quantity of organic matter, which affords nourishment to the oysters. Transferred to such places the oyster is considerably improved in size and taste; the liver is more particularly increased; and the shells become more regular, because the animals are so openly scattered as

not to interfere with one another. On account of the water being less salt (2·9–3·1) the shells are thinner than on the natural banks, in accordance with what has been observed also in the case of other testaceous mollusks. Through these changes the oyster is improved as an article of food and commerce; but the improvement is not attained without another effect, which accompanies artificial fattening of animals as commonly as the abnormal increase of the liver does, and which is of the greatest importance for the whole question of oyster-culture. All the physiological energy of the animal being concentrated on the development of the individual, another side of its life, its capability for continuing the species, is impaired. Several authors have noticed the small quantity and limited vital power of the spat produced by oysters in artificial parks; but the fact has not as yet received the attention it deserves; it has not been observed that it is a regular effect of less salt water and that consequently parks for fattening oysters cannot be self-supporting in the long run.

A diminution of the saltness of the sea amounting to 0·5, in connexion with certain other physical circumstances, particularly an admixture of fresh water, is consequently enough to exercise a notable influence on the development of the oyster generally, and especially on its power of propagation. This check will increase in effectiveness with the admixture of fresh water; and there is a point where the individual oyster is still perfectly able to live and thrive, but unable to propagate the species. Experience shows that oysters are able to live long in water of much less saltness, and even attain a size and delicacy which could not be reached if any part of its vital power were to be spent on propagation of the species. The minimum of saltness compatible with the existence of oysters has not yet been determined; and the circumstance that the animal is very susceptible to cold, if the saltness of the water decreases, renders experiment on this point very difficult. Von Baer puts this minimum at 1·7; but propagation is then out of the question. In several instances different banks in the same locality have been found to exhibit great differences with regard to fertility; and it has been suggested that the reason might be that the products of the generative organs do not come to maturity in all individuals at the same time. But it is probable that their more or less favourable situation in regard to the access of salt water is of not less importance in the matter—particularly as the degree of saltness of the water would probably show its effects not only in increasing or diminishing the general fertility, but also in accelerating or delaying the maturity of the secretions in question.

From the preceding it appears that the physiological conditions of the oyster, and especially its power of propagation, may be changed or checked through modifications of circumstances, such as admixture of fresh water or greater tranquility of the water, in respect of which there may be notable differences between localities situated at short distances from one another; and it is evident that this circumstance must act as a bar to its diffusion over a wider area, particularly because it is combined with this other peculiarity, that the brood of oysters is capable of surviving, freely drifting about, only for a short time after having left the mother; it must sink to the bottom after a certain time, and remain where it sinks, whether the place is favourable for its development or not. A very gradual modification of the kind indicated occurs in the water of the Kattegat, where the salt water of the North Sea meets and is gradually mixed with the fresher water of the Baltic; and accordingly the oyster becomes more and more rare as we proceed southwards. At the entrance to the Sound and the Belts the species ceases to occur, though the water is not fresher than it might survive and even thrive in; but it could not propagate there; and the nearest place where the physical conditions of the water permit it to do so, viz. the Bay of Aalbæk, just south of the Skaw, is so far away that the spat, drifting with the current, must, as a rule, sink before it arrives so far. Between these banks and the southern limits of the oysters in the Kattegat they occur only seated on large stones, singly or rarely three or four together. These scattered individuals are often large and fat, but they are barren.

With regard to parks for fattening oysters the main result of these considerations is, that they may be established in places where the water is much less salt than on the natural banks, if otherwise the conditions are favourable, as to temperature, quality of the bottom, quantity of food, &c.; but they cannot be made self-supporting. If artificial banks are to be self-supporting the water must not be much less salt than on the natural banks from which they are stocked.

XXIII.—*Note on Selaginopsis (= Polyserias Hincksii, Mereschkowsky), and on the Circumpolar Distribution of certain Hydrozoa.* By the Rev. A. M. NORMAN, M.A.

THE *Polyserias Hincksii* of Mereschkowsky, recently figured in the 'Annals' (ser. 4, vol. xx. pl. vi. figs. 15, 16), from the White Sea, is, I think, unquestionably identical with